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Claims

- Sub R1 →
- [c1] 1. A lamp comprising:
an LED module including at least one LED arranged on a substrate;
an optical system comprising at least one lens in optical communication with the LED module; and
a zoom apparatus that selectively adjusts the relative axial separation of the optical system and the LED module.
- [c2] 2. The lamp as set forth in claim 1, wherein the LED module comprises:
a plurality of LED's arranged in a first pattern on the substrate.
- [c3] 3. The lamp as set forth in claim 2, wherein the at least one lens comprises:
a plurality of Fresnel lens arranged in a second pattern that corresponds with the first pattern.
- [c4] 4. The lamp as set forth in claim 2, wherein the optical system comprises:
a plurality of lenses wherein each lens is axially aligned with an LED and optically communicates with said LED.
- [c5] 5. The lamp as set forth in claim 1, wherein the zoom apparatus comprises:
a first sleeve having the LED module arranged thereon, the first sleeve further having a first threading arranged thereon; and
a second sleeve having a second threading arranged thereon that is adapted to cooperate with the first threading such that the first sleeve and the second sleeve are relatively movable in a screwing fashion, the second sleeve further having the optical system arranged thereon.
- [c6] 6. The lamp as set forth in claim 5, further comprising:
an index system that relatively biases the first sleeve and the second sleeve into one or more selectable relative axial positions.
- Sub R2 →
- [c7] 7. The lamp as set forth in claim 1, wherein the zoom apparatus comprises:
a first element having the LED module disposed thereon; and
a second element adapted to slidably connect with the first element, the second element further having the optical system disposed thereon.

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- [c8] 8. The lamp as set forth in claim 7, wherein the zoom apparatus further comprises:
a mechanical interlock between the first and the second elements that prevents relative rotation therebetween.
- [c9] 9. The lamp as set forth in claim 8, wherein the mechanical interlock comprises:
a protrusion on one of the first and the second elements, the protrusion being aligned parallel to the optical axis; and
a groove on one of the first and the second elements that receives the protrusion to prevent relative rotation of the first and the second elements.
- [c10] 10. The lamp as set forth in claim 7, further comprising:
a stop that relatively biases the first and the second elements into one or more selectable relative axial stop positions.
- [c11] 11. The lamp as set forth in claim 7, wherein the LED module further comprises:
a heat sink thermally connected with the substrate for cooling the LED module.
- [c12] 12. A light source comprising:
an LED module including a plurality of LED's for generating a lamp beam; and
an adaptive optical system for selectively adjusting the angular spread of the lamp beam.
- [c13] 13. The light source as set forth in claim 12, wherein the adaptive optical system comprises:
a plurality of lenses; and
one of:
two slidably interconnected sleeves, and
two threadedly interconnected sleeves,
the first sleeve being connected with the LED module, and the second sleeve being connected with the plurality of lenses.
- [c14] 14. The light source as set forth in claim 12, wherein the adaptive optical system comprises:

a plurality of lenses;

two cylindrical threadedly interconnected sleeves, the first sleeve connected with the LED module, and the second sleeve connected with the plurality of lenses; and

a mechanical index system that biases the threaded interconnection of the two sleeves into selectable stop positions.

[c15] 15. The light source as set forth in claim 14, wherein the selectable stop positions include:
stop positions that axially align each LED of the LED module with one of the plurality of lenses.

[c16] 16. The light source as set forth in claim 12, wherein the adaptive optical system comprises:
a plurality of lenses arranged into an n-fold rotationally symmetric pattern corresponding to a rotational symmetry of the arrangement of the plurality of LED's;
two cylindrical threadedly interconnected sleeves, the first sleeve having the LED module disposed therein, and the second sleeve having the plurality of lenses disposed therein; and
a stop mechanism that biases the threaded interconnection of the two sleeves into selectable stop positions that are angularly separated by integer multiples of $360^\circ / n$ degrees, where n corresponds to the n-fold rotational symmetry of the arrangement of the plurality of lenses.

[c17] 17. A lamp comprising:
a light source;
an optical system comprising at least one lens in optical communication with the light source; and
a zoom apparatus that selectively adjusts the relative axial separation of the optical system and the light source.

[c18] 18. The lamp as set forth in claim 17, wherein the zoom apparatus comprises:
one of:
two slidably interconnected sleeves, and

two threadedly interconnected sleeves,
the first sleeve having the light source arranged thereon, and the second sleeve
having the optical system arranged thereon.

FIG. 10